An Attachment Structure in an Epiparasitic Gastropod

BY

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(1 Text figure)

AN ECTOPARASITIC LIFE STYLE generally involves the development of specialized organs of attachment, as in the case of flatworms and arthropods where an array of simple to elaborate hooks, suckers, and spines has been well documented. However, among gastropod mollusks, not only is the ectoparasitic habit rare, but the development of specialized attachment structures has only been reported in one species of prosobranch mollusk (VERRILL, 1897). No attachment organ with the possible exception of the foot has ever been noted in any of the ectoparasitic gastropods.

The opisthobranch gastropod family Pyramidellidae consists of ectoparasites that feed on the body fluids of other mollusks and polychaete worms using a stylet on the end of a protrusible proboscis (FRETTER & GRAHAM, 1949). CLARK (1971) reports that the pyramidellan, *Odostomia columbiana* (Dall & Bartsch, 1909), responds to the surface texture of its host, the mesogastropod, *Trichotropis cancellata* (Hinds, 1848). Also, the heavily spiny periostracum is highly attractive to this parasite, and has positive adaptive value in that it prevents the parasite from being dislodged by strong currents. Yet the parasites are seen to move freely over all parts of the shell and also are able to move from one host to another.

While in residence at the Friday Harbor Laboratories during the spring of 1978, I had the opportunity to study host-parasite relationships between these 2 species of gastropods. The snails were collected in what is called the "potato patch" of East Sound, off Orcas Island, Washington, in approximately 30 m of water. Approximately 52 specimens of *Trichotropis cancellata* were dredged and 46% were found to be infected with *Odostomia columbiana*. The mean number of parasites per host equaled 1.62 ± 0.64 S. D. The snails were maintained in the laboratory in a 30 gallon [108 L] capacity plexiglass aquarium that was supplied with running sea water.

In the first attempts to remove some of these small pyramidellans from the surface of their host, one slipped from the grasp of the forceps. This was a most fortuitous accident, for the *Odostomia* did not fall to the bottom of the sea water-filled bowl, but was caught on the edge of the dorsal lip of the host's shell, approximately 7 mm from where it originally rested. It appeared to be held in place by a thread that was still attached to its former position on the surface of the shell. Removing the *Trichotropis* from the water, the attachment thread of the parasite became apparent under the dissecting microscope; so it appears that the thread has an optical density similar to that of sea water, since it is relatively invisible while under water. The attachment thread seems to be quite elastic and resilient, for when the *Odostomia* was carefully nudged away from the edge of the shell of *Trichotropis* with the tip of the forceps, it snapped back to its original position on the surface of its host. Stretching tends to reduce the elasticity of the thread, and if it is stretched more than 15 mm, the thread will break and the parasite will lose contact with its host. To test whether the parasites could re-establish their attachment threads, the following experiment was undertaken. Twelve *Odostomia* were removed from the surfaces of a number of *Trichotropis*, thus severing the attachment threads, and then placed on the surfaces of new hosts. By the following day, 9 of the parasites had re-attached, forming new threads.

An aqueous saturated solution of neutral red selectively stains the attachment threads, making them readily visible. Staining a shell of *Trichotropis* from which 2 *Odostomia* had previously been removed demonstrated at least 6 attached fragments. Since more attached fragments were visible than the number of parasites removed, it appears that the parasites are able to sever their own threads and produce new ones as they move about their hosts in a fashion similar to mussels utilizing their byssal fibers.

The thread originates from the extreme posterior ventral surface of the foot (Figure 1). The margin of the posterior region is plicate, and there appears to be a median central pore from which the thread emerges. In addition, there is a ciliated median groove running up the antero-posterior axis of the foot terminating near the tip of the propodium. The function or role of this groove was difficult to determine and cannot be answered here.

La Follette (1977) has noted in dead and dried *Chrysallida cincta,* also a pyramidellid, on *Norrisia norrisii* that the snails remain attached to their hosts. They may have been held in place by dried attachment threads.

Normally, in gastropods, the foot is the major adhesive organ. What adaptive function might be served by possessing an additional attachment structure? This question is best answered by looking at the habitat of the host and the feeding behavior of the parasite. Yonge (1962) records that *Trichotropis cancellata* is restricted to hard bottomed subtidal substrates, consisting mostly of dead bivalve shells, that are repeatedly buffeted by strong tidal currents. A suspension feeder, it is relatively sedentary by habit in that it moves as high as possible on a vertical surface and stays there. When feeding, *Odostomia columbiana* stations itself near the very edge of the aperture of the host's shell in order to reach the soft mantle tissues with its long proboscis. This appears to be a precarious position, even on a relatively sedentary host with a spiny periostracum, given the force of the turbulent water and the vertical orientation of the host. The development and evolution of the attachment thread as an additional "life line" has positive adaptive values for *O. columbiana.*

Such attachment threads in gastropods may be more common than first realized. Verrill (1897) first noted threads of adhesive mucus formed by the foot glands of many land slugs and certain marine gastropods as well. He reports that the sargassum snail, *Litiopa bombyx* (Rang, 1829), attaches itself to its floating algal home by a thread of adhesive mucus. This was later verified by Waller (1975) in *L. melanostoma,* a synonym of *L. bombyx* (Abbott, 1974). Cadet Hand (personal communication) has observed the dove shell, *Mitrella carinata* (Carpenter, 1865), that inhabits the rocky intertidal zone of the Pacific coast of the United States attaching itself to the substrate by a thread of mucus secreted by the foot. In addition, I have observed on at least 7 different occasions while snorkeling in the Florida Keys the bubble shell, *Bulla striata* (Bruguière, 1792), hanging from a mucus thread after having dislodged them from a vertical facing wall. Dr. Hand feels that such forms of attachment may be size-related in that all the gastropods that demonstrate this phenomenon are quite small, generally less than 12 mm in length. Verrill (*op. cit.*) has hypothesized an evolutionary relationship between mucus threads and the byssal threads of the bivalve mollusks. He suggests that the earliest form of attachment was temporary, perhaps being aided by mucus secretion from the surface of the foot. He notes that "such a mode of adhesion to objects is common among planarians, small nemerteans, annelids, and the young forms of many groups at the present time"; also, "from such a primitive adhesive foot the transition to a larger foot with more specialized cells situated in a groove for the secretion of stronger byssus-like threads of mucus would have been easy."

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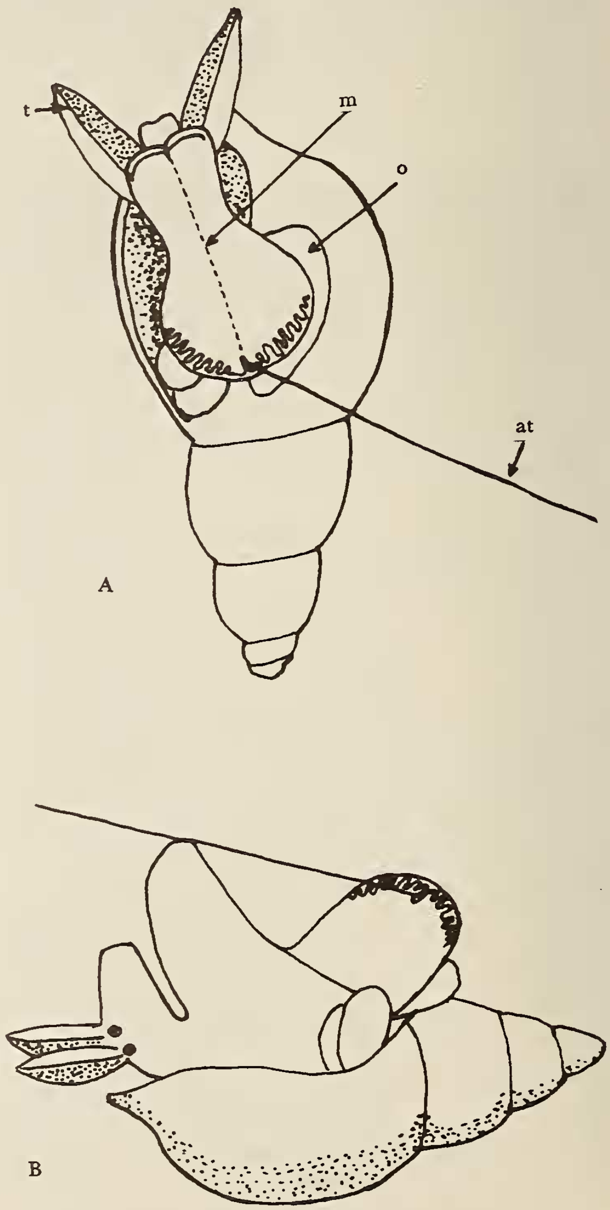

Figure 1

Ventral and lateral perspectives of overturned specimens of *Odostomia columbiana* showing relationships of attachment thread (at) to the foot. o – operculum t – ear-like tentacle

Snails are approximately 2 mm in length

Literature Cited

ABBOTT, ROBERT TUCKER
1974. American seashells. 2nd ed., 663 pp.; 24 col. plts. Van Nostrand Reinhold, New York

CLARK, KIRSTEN
1971. Host texture preference of an ectoparasitic opisthobranch, *Odostomia columbiana* Dall & Bartsch, 1909. The Veliger 14 (1): 54-56; 1 plt. (1 July 1971)

FRETTER, VERA & ALASTAIR GRAHAM
1949. The structure and mode of life of the Pyramidellidae, parasitic opisthobranchs. Journ. Mar. Biol. Assoc. U. K. 28: 493-532

LA FOLLETTE, PATRICK I.
1977. Inbreeding and intraspecific variation in *Chrysallida* Carpenter, 1857 (Gastropoda: Pyramidellidae). Ann. Reprt. West. Soc. Malac. 10: 18-23 (14 December 1977)

VERRILL, ADDISON EMERY
1897. A study of the family Pectinidae, with a revision of the genera and subgenera. Trans. Connect. Acad. Arts & Sci. 10: 41-95

WALLER, THOMAS R.
1975. The behavior and tentacle morphology of pteriomorphian bivalves: a motion picture study. Bull. Amer. Malacol. Union 7-13

YONGE, CHARLES MAURICE
1962. On the biology of the mesogastropod *Trichotropis cancellata* Hinds, a benthic indicator species. Biol. Bull. 122: 160-181